

## CAVE-ASSOCIATED TROPICAL AMERICAN *NEODITOMYIA* (DIPTERA: MYCETOPHILIDAE)

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*Abstract.*—With the addition of the adults of two new species of *Neoditomyia*, as well as the larva of one, seven species are now known for this cave-associated genus. Flies of this genus are Neotropical in distribution. The first detailed figures of the male terminalia of *N. aeropiscator* (Jackson) and the larval head of *N. farri* NEW SPECIES are given.

*Key Words.*—Insecta, Diptera, Mycetophilidae, Caves, Tropical America

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The genus *Neoditomyia* Lane & Sturm, 1958 was proposed for two Neotropical species of mycetophilids whose larvae spin webs bearing droplets, possibly of oxalic acid (Buston 1933), to catch and kill prey. The web-spinning habit is well known for other genera of keroplatine fungus gnats with predaceous larvae, such as *Macrocera* (Matile 1975) and *Arachnocampa* (Hudson 1950). Since that time three Circumcaribbean species have been described, one each from Honduras, Trinidad and Cuba. In this study, the adults of two new species are described, one from Jamaica, West Indies and one from Brazil, the latter known only from adult males taken in a Malaise trap, but with no data on whether in or outside of a cave.

In January, 1961, I visited the Institute of Jamaica, West Indies, and Thomas Farr of the Institute and I climbed the Blue Mts. and visited the Windsor Great Cave. Entrance into the cave with nothing but flashlights was a bit overly bold. However, we persisted on penetrating the inner cave, our only mishap being a “Nantucket sleighride” down a large slanting boulder covered with bat guano. At its bottom, in a large chamber, we were soon enveloped in clouds of ceratopogonids that were attracted to the lights. The most striking thing about the upper chamber walls of the cave was the presence of a covering of webs, sticky to the touch, with dangling ‘fishing lines’. Slim, worm-like, cream-colored larvae with a prominent head capsule were resting in the webs. On the lines were tiny droplets. A brief search for pupae and adults of the larva, recognized to be a keroplatine, was of no avail. Some years later Thomas Farr sent me males and females of this fly taken in Windsor Great Cave. They proved to be a new species of *Neoditomyia*, a known Neotropical cave-dwelling orfeliine genus.

*Neoditomyia* was originally described as a ditomyiine; it encompassed two new cave inhabiting species from Colombia with *N. colombiana* designated as the generotype. Coher (1963) suggested that they were platyurines and more properly belonged in *Platyura* (*Taulyrpa*) Edwards, 1929. Nicholas (1968) reported the presence of luminescent dipterous larvae in two caves in Guatemala. The larval web that he illustrated is similar to that of *Neoditomyia*, but it would be the only luminescent species of that genus if that is its affinity. Sturm (1973) reviewed the biology of the two Colombian species in detail.

*Orfelia aeropiscator* Jackson, 1974 was described from adults reared from pu-

pae taken in a Honduran cave. Larvae that he found outdoors living in webs on the underside of leaves in Costa Rica were ascribed to *O. aeropiscator*; confirmation of this observation is needed. Jackson made valuable observations on the biology of these larvae, but apparently did not rear any.

Matile (1975) described adults and larvae of a new species *N. trogliphila* from caves in Cuba, and correctly placed *O. aeropiscator* in *Neoditomyia*. In 1982, he described the male and female of *N. spinosa* and reviewed the bionomics and phylogeny of the genus. A slight modification is discussed below.

A report on cave and roadside webs by Cook (1913) is rather limited. The webs that he and Barber (*in* Cook 1913) noted could mean that his fly and that of Nicholas represent a rather widespread species of as yet uncertain affinities.

#### *Neoditomyia* Lane & Sturm, 1958

*Neoditomyia* Lane & Sturm 1958:199.

*Platyura (Taulyrpa)*: Coher 1963:23.

*Orfelia (Neoditomyia)*: Matile 1972:113.

*Neoditomyia*: Matile 1975:369.

*Type Species*.—*N. colombiana* Lane & Sturm, 1958:199 (original designation).

*Description*.—Head: antenna compressed, 2+14 segmented, length subequal to mesonotum, scape with apical ring of short setae; flagellar segments broader than long, penultimate segment nearly square, apical segment longer than wide, apex rounded; palpus with 4 segments, basal segment greatly reduced, segment 2 slightly inflated, segments 2 and 3 strongly setiferous, length of apical segment equal to combined length of segments 2 and 3; posterior clypeus setifereous, frons bare; vertex and occiput with abundant, short setae, occipital area with shortened seta ventrally, a tuft of long setae at lower posterior corner of compound eye; ocellar prominence black with 2 large ocelli separated by less than their diameter, separated from eye margin by more than ocellar diameter. Thorax: with patch of precoxal setae; mesonotum with variable pattern, heavily clothed with short, dark setae and longer lateral setae, either with short posteromedian stripe that continues onto scutellum, *or* with distinct V-shaped stripe with apex at mid-posterior margin continued onto scutellum, arms of 'V' broadly connected to a wide, heavily setose anterolateral area, a narrow median stripe also present *or* appearing as broad median stripe that is wider anteriorly; humeri lightly pigmented; area of median pattern appearing somewhat raised from remainder of the mesonotum; anterior and posterior margin of both spiracles bearing row of strong, dark setae; anterior and posterior pronotum setose; proepisternum with patch of setae; anterodorsal anepisternite with wide, linear patch of strong, dark setae; katepisternite at an angle to anepisternite; mesopleuron bare; pleurotergite heavily setose; scutellum and median postnotum densely setose; metepimeron bare. Wing 6.0 mm long; costa ending well beyond apex of  $R_5$ ,  $Sc$  short, ending free;  $R_s$ ,  $Sc$ ,  $M$ ,  $Cu$  and their branches bare,  $M_{3+4}$  not quite reaching wing margin,  $Cu_2$  reaching or not; halter with knob setose, base dark, widened apically with bare membranous area occupying most of apex. Legs: forecoxa with heavy anterior setae, group of 2–7 large posterolateral apical setae; femora setose; tibiae and tarsi with setae in rows; tibial spur formula 1-1-1, ratio of tibial spurs 1/2/4, apex of midtibia with an internal comb, apex of hind tibia expanded, combs on both internal and external surfaces. Abdomen: unicolorous, heavily setose. Terminalia: male; all dististyles with a median internal compressed process (= median plate).

*Larva*.—Apneustic. Head with typical elongate, forward-projecting, subtriangular maxillae of keroplatine larvae (Fig. 1); mandibles subrectangular with apical edge toothed in a roughly double row (Fig. 1); stemma large, below posterior antenna (Fig. 1); anterior head capsule with epicranial plates separated by membranous area; V-shaped submentum heavily sclerotized and pigmented, connected to premental sclerite; with scimitar-shaped submaxillary sclerites; abdomen with 6 pigmented creeping welts, widest medially, first and last as single row, others in double row (Fig. 1), all welts under high magnification appearing as rows of fine hairs; terminally with 2 soft lateral papilla as in *Macrocera* (Mansbridge 1933).

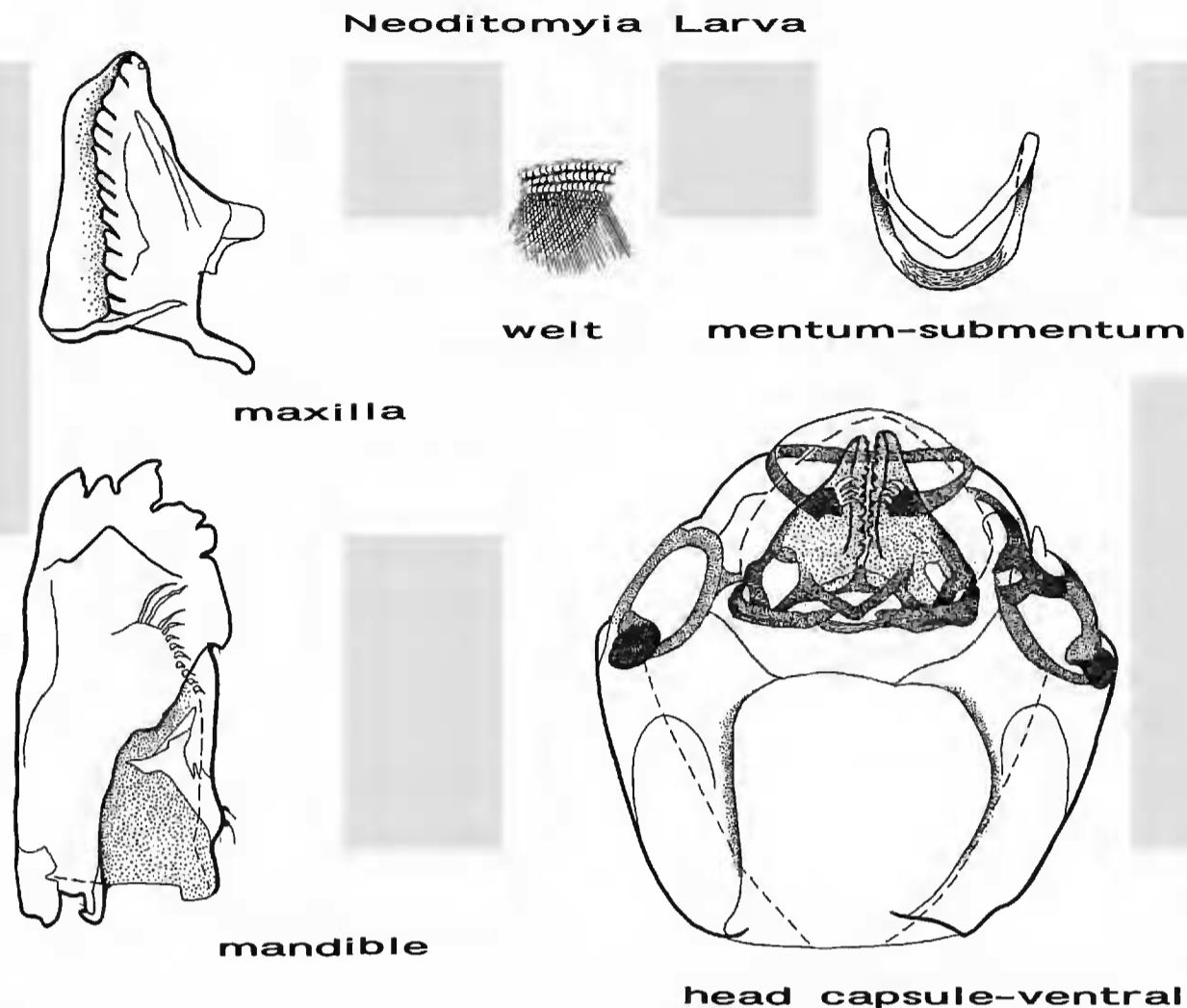


Figure 1. *Neoditomyia* larvae. Maxilla, welt, mentum—submentum, mandible, ventral view of head capsule.

### *Neoditomyia farri* Coher, NEW SPECIES

*Types*.—Holotype male: JAMAICA. TRELAWNY: Windsor Cave, 25 Aug 1955, T. H. Farr; deposited: California Academy of Sciences, San Francisco. Allotype: With the same data as the holotype; deposited: California Academy of Sciences, San Francisco. Paratypes: Same date as holotype, 2 males deposited: Institute of Jamaica and Coher collection; same data as holotype, but 14 May 1956, T. H. Farr (deposited: Institute of Jamaica), females; Dromilly Cave, 4 Nov 1992, reared from pupa collected 24 Oct 1992, I. Stringer (deposited: Institute of Jamaica). 17 Jan 1961, E. I. Coher and T. H. Farr 1 larva (deposited: California Academy of Sciences).

*Male*.—Head: antenna with scape and pedicel slightly yellow, flagellar segments brown or yellow-brown; palpus yellow; clypeus and frons slightly yellow; vertex and occiput appearing brown due to presence of abundant, short setae, occipital area appearing slightly yellow laterally; ocellar prominence black, attenuated posteriorly; eyes sparsely setiferous, narrowed dorsally above level of antennal base. Thorax: mesonotum (Windsor form) with variable pattern, heavily clothed with short, dark setae and longer lateral setae, either yellow-brown with short posteromedian stripe that continues onto scutellum, *or* with distinct pattern of V-shaped brown stripe with apex at mid-posterior margin continued onto scutellum and arms of 'V' broadly connected to wide, heavily setose anterolateral brown area, narrow median brown stripe also present *or* appearing as broad median brown stripe that is wider anteriorly; humeri lightly pigmented; area of median pattern appearing somewhat raised from remainder of mesonotum. Alternatively mesonotum (Dromilly form) lighter with distinct pattern of V-shaped brown stripe with apex at mid-posterior margin continued onto scutellum, apical arms of 'V' with distinct broad patch of setae; pleura nearly yellow. Wing 5.0 mm long; suffused, darker apically in cell R<sub>5</sub>, slightly lighter in anal cells; R<sub>4</sub> slightly sinuous or not. Legs: coxae and tibiae yellow, forecoxa with heavy

anterior setae and a group of 2–7 large posterolateral apical setae; tibiae and tarsi brown. Abdomen: yellow-brown. Terminalia: (Fig. 2). Setation less (Dromilly male) to strongly developed (Windsor males).

*Female*.—Similar to male; mesonotum (Windsor form) with pattern of broad median stripe that is wider anteriorly or may be obsolete along its middle so that there are pair of brown spots anteriorly and single median one posteriorly. Alternatively, mesonotum (Dromilly female) similar to Dromilly male; wing 5.0–6.5 mm long.

*Larva*.—(Fig. 1). With characteristics given for the genus.

*Diagnosis*.—The males of *N. farri*, and its sibling *N. spinosa* Matile, are easily differentiated on the basis of the shape of the dististyle, which is strongly triangulate in *N. spinosa* and bluntly triangulate in *N. farri*. The setal tuft at the base of the dististyle of *N. spinosa* is attenuated basally and is broad in *N. farri*.

*Discussion*.—The flies from Dromilly Cave in Jamaica were furnished by I. A. N. Stringer. He is involved in studies of the bionomics of this fly, which he has succeeded in rearing. This is undoubtedly the species noted by Matile (1982) as having been collected by A. S. Peck (1975); I have not been able to determine where those specimens have been deposited. A comparative study of the anatomy and bionomics of the larvae of these apparently troglobitic sibling species is needed.

*Entomology*.—This species is named for Thomas H. Farr whose contribution to this study was invaluable.

*Material Examined*.—See types.

#### *Neoditomyia para* Coher, NEW SPECIES

*Types*.—Holotype male: BRAZIL. PARA: Santo Antonio de Tauà, April 1980, M. Boulard, Malaise trap; deposited: Museum National d'Histoire naturelle, Paris. Paratypes: Males (4). Same data as the holotype but, October 1979 (1 male), February 1980 (1 male), March 1980 (2 males), M. Boulard, all taken in a Malaise trap (1 deposited: Museum National d'Histoire naturelle, Paris; others retained by Coher).

*Male*.—Head: antenna with scape and pedicel slightly yellow; flagellar segments brown or yellow-brown, apical 5 segments variably darkened or not; palpus yellow or yellow-brown; clypeus and frons light yellow-brown; vertex and occiput appearing light brown due to presence of abundant, short setae, occipital area light yellow-brown laterally. Thorax: mesonotum heavily clothed with short, dark setae, longer lateral setae, nearly yellow-brown with distinct V-shaped brown stripe with apex at mid posterior margin, arms of 'V' broadly connected to wide, heavily setose anterolateral brown area, narrow median brown stripe of variable length present; pleura light yellow-brown. Wing 4.5–5.0 mm long; entirely suffused, or cells  $R_3$ ,  $R_4$ ,  $R_5$  and  $M_2$  darker (1979 paratype); costa ending well beyond apex of  $R_5$ , Sc short, Sc, M and its branches and  $Cu_1$  bare,  $M_{3+4}$  not reaching wing margin,  $Cu_2$  reaching or not; halter with brown stem, knob setose, slightly white, base dark. Legs: coxae and femora yellow, forecoxa with heavy anterior setae and group of 5–7 large posterolateral apical setae; tibiae, tarsi brown, setae arranged in rows. Abdomen: yellow-brown. Terminalia: (Fig. 2).

*Female and Larva*.—Not known.

*Diagnosis*.—*N. para* is most closely related to *N. farri*. The Brazilian species has a distinctive bifid median internal compressed process.

*Discussion*.—The presence of *N. para* in Brazil extends the range of the *Neoditomyia* from several Caribbean Islands, Central America and northwestern South America to the eastern Neotropical Region. Roughly the range of the genus is now between 16° N and 4° S latitude. This will correct data presented by Matile



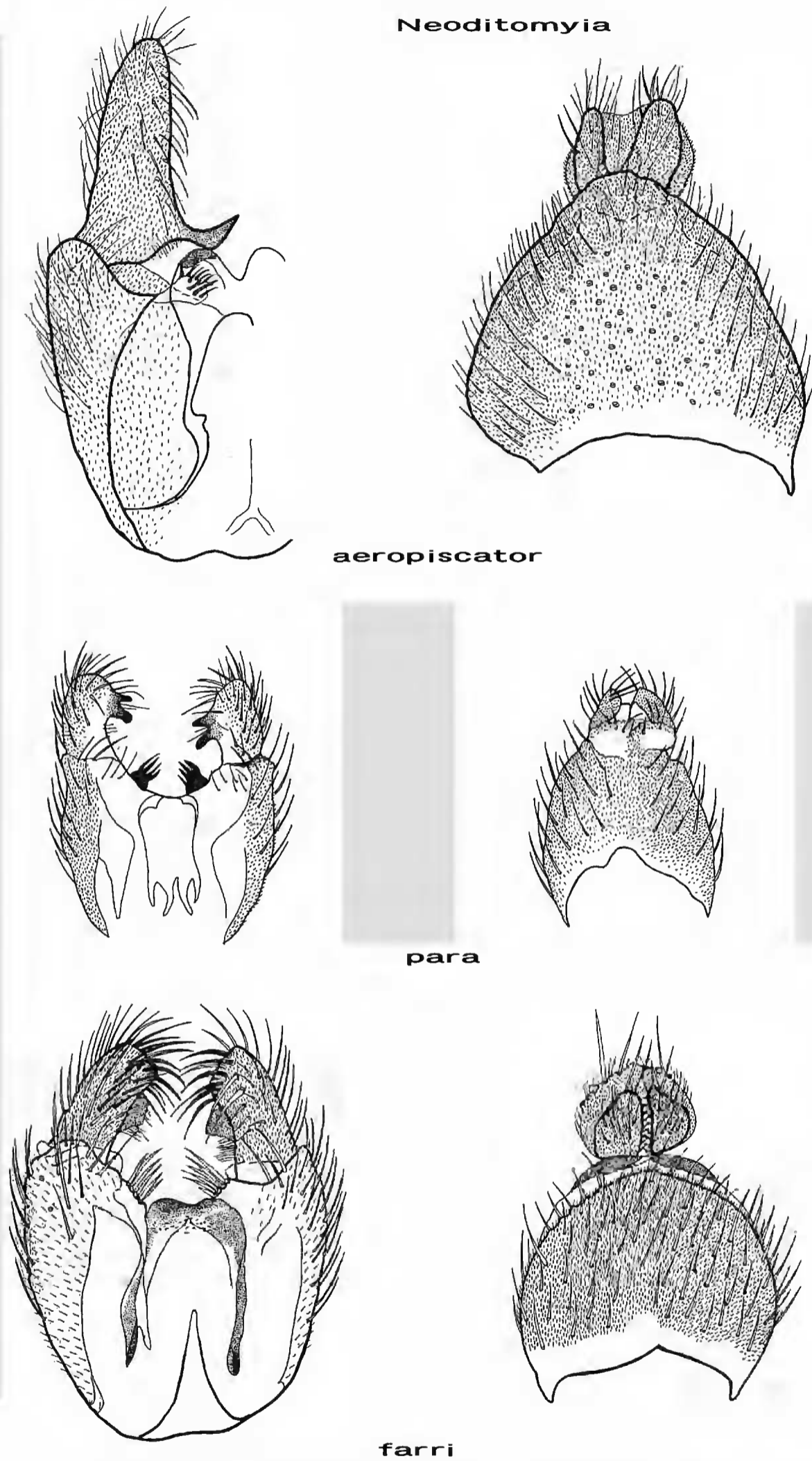


Figure 2. Terminalia. *N. farri* NEW SPECIES, *N. para* NEW SPECIES, *N. aeropiscator*. Illustrations are drawn to scale, with dorsal aspect with tergal portion to right.

(1982) because my examination of the species reported by him from southern Brazil as *Neoditomyia* is not that, but actually represents a new genus. There are no data on the collection labels to indicate whether the adults were taken in or near a cave.

*Neoditomyia aeropiscator* (Jackson), 1974

*Orfelia aeropiscator* Jackson 1974: 240.

*Neoditomyia aeropiscator*: Matile 1975: 369.

*Neoditomyia aeropiscator*: Matile 1982: 229.

*Remarks.*—British Honduras, Cayo District. The original drawings of the male terminalia and larva of this species were not in detail; the male terminalia are re-drawn here (Fig. 2). There are no further records of this species. Although Pappavero (1978) indicated that he was erecting a new combination for this species, it had already been done by Matile (1975).

*Neoditomyia andina* Lane & Sturm, 1958

*Neoditomyia andina* Lane & Sturm 1958: 201.

*Platyura (Taulyrpa)*: Coher 1963: 23.

*Neoditomyia andina*: Sturm 1973: 61.

*Neoditomyia andina*: Matile 1982: 229.

*Remarks.*—Colombia, Sierra de la Macarena, 400 to 500 m. No further collection data. The larva and pupa and their bionomics were well described in the original study and in further studies by Sturm (1973).

*Neoditomyia colombiana* Lane & Sturm, 1958

*Neoditomyia colombiana* Lane & Sturm 1958: 204.

*Platyura (Taulyrpa)*: Coher 1963: 23.

*Neoditomyia colombiana*: Sturm 1973: 61.

*Neoditomyia colombiana*: Matile 1982: 229.

*Remarks.*—Colombia, Resina, 1600 to 2000 m altitude. No further collection data. The larva and pupa are described by Lane & Sturm (1958) with amplification by Sturm (1973). I have borrowed the holotype of *N. colombiana*. The specimen is intact, therefore the original drawings must have been made from a paratype.

*Neoditomyia spinosa* Matile, 1982

*Neoditomyia spinosa* Matile 1982: 205, 229.

*Remarks.*—Dominica, in several locales, no further collection data. Only the holotype male was taken in a cave, the allotype and a paratype male are not noted as being found in caves. The larva and pupa are unknown.

*Neoditomyia trogliphila* Matile, 1975

*Neoditomyia trogliphila* Matile 1975: 369.

*Neoditomyia trogliphila*: Matile 1982: 229.

*Remarks.*—Cuba, but no further collection data. Described from both sexes and larvae taken in seven caves.

## BIONOMICS

The presence of eyes in both the adult and larva and of pigmentation in adult *Neoditomyia* indicates that cave habitation is probably not a geologically ancient development for the genus. The vicariant distribution in caves supports Matile's (1982) contention that the cave habitat resulted after loss of a more widespread habitat. Although I consider that several species may be troglobites, the retention of eyes and pigment may indicate that there are extra-cave populations that interbreed with the cave-inhabiting forms and thus maintain anatomical and coloration characteristics expected from populations outside the cave.

The terminalia of male *Neoditomyia* vary around modifications of the shape of the dististyle and its median plate, the shape of the setal tuft at the base of the dististyle and the shape of the central gonostyle. Except for genitalia, I can discern no sexual dimorphism of any species. Adult coloration characteristics await a larger sampling before they can be considered to be useful. Larval differences apparently center around the shape of the mentum-submentum. Comparison of the structure of the larval webs would be of value, but cannot be evaluated based on data that is available.

Larval and/or pupal collections indicate that *N. aeropiscator*, *N. farri*, *N. spinosa* and *N. trogliphila* may be troglobitic, but *N. andina* and *N. colombiana* are trogliphilic at best. The larvae of *N. andina*, and *N. colombiana* were found in humid conditions on rocks or hanging from vegetation (leaves, fallen tree trunks). The immatures of *N. para* are unknown and the exact provenance of the adults is not known.

As yet there is no detailed anatomical description of *N. aeropiscator* larvae. Larvae from Costa Rica ascribed to *N. aeropiscator* by Jackson (1974) have not been reared, and because adults and larvae from Honduras were taken only in caves and the larvae from Costa Rica were found outside on foliage, their relationship to *N. aeropiscator* needs further examination.

The larval web of *Neoditomyia farri* is similar to that described by Lane & Sturm (1958), Sturm (1973) and Jackson (1974). It provides a larval habitat and functions with its sticky droplets to capture or kill prey Buston (1933). In Jamaica, I found numerous ceratopogonids entangled on the 'fishing lines'. These flies, easily captured in large numbers, have been identified by W. Wirth as a yet undescribed species of *Dasyhelea* (Diptera: Ceratopogonidae). They have been deposited in the collection of the California Academy of Sciences. In addition, a single small empid was taken.

In Windsor Great Cave, webs on the wall surface appeared as threads of silk with larvae apparently enclosed in their own mucus and stretched out on horizontal lines. The long, slim larvae were able to slide back and forth on these lines. It could not be determined at that time whether the larvae could glide backwards or whether they performed a 'U-turn' to reverse direction. Sturm (1973) reported that they can perform either function. Other orfeliines such as *Platyura fultoni* move in their webs in a similar manner (Fulton 1941). Vertical fishing lines were noted to be roughly up to 12 cm long with droplets of a sticky substance. The distribution of these droplets was not noted. A sample of the larvae, which occurred isolated from each other, was taken. The form of the web

almost certainly seems to have evolved in caves and rock shelters where air turbulence would not interfere with development and desiccation.

Unfortunately, Lane & Sturm (1958) give a dorsal view of the head capsule of *N. colombiana* and a ventral view of the head capsule of *N. andina*, so that they cannot be fully compared. The submentum in *N. farri* is labelled hypopharynx by Lane & Sturm (1958). I have not been able to examine larvae other than those of *N. farri*.

#### ACKNOWLEDGMENT

I thank Thomas Farr (Institute of Jamaica) for helping to obtain material of the species dedicated to him; Ian Stringer (Massey University, New Zealand), who kindly allowed me to study his flies from the Dromilly Cave in Jamaica; Loic Matile, who has allowed me to include a new Brazilian *Neoditomyia* sent to him for study; R. J. Gagné (U.S. National Museum of Natural History, Washington, D.C.), who arranged a loan of *N. aeropiscator* paratypes gave valuable recommendations on the development of this study; and Annette Vollers, for her extreme patience and good humor in joining me to develop all the rough pencil and final inked drawings.

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